REMARKS

Overview of the Office Action

Claims 6, 11, and 12 have been objected to for various informalities.

Claims 1-8 and 12-14 have been rejected under 35 U.S.C. §103(a) as unpatentable over U.S. Patent No. 6,100,104 ("Haerle") in view of U.S. Patent No. 5,693,962 ("Shi").

Claims 9-11 have been rejected under 35 U.S.C. §103(a) as unpatentable over Haerle in view of Shi, and further in view of U.S. Patent No. 6,110,177 ("Braun").

Status of the claims

Claims 1-14 have been amended

Claim 15 has been newly added.

Claims 1-15 are now pending

Amendments to the specification

Applicant's originally filed specification included an error in translation from applicant's German language International Application. Specifically, in the paragraph bridging page 2, line 36 to page 3, line 4, the word "propagation" should have been "extent". Indeed, this paragraph makes no sense using the word "propagation". Further, it is the only paragraph in which the word "propagation" appears. Accordingly, this error is apparent.

Therefore, the paragraph bridging page 2, line 36 to page 3, line 4 of the originally-filed specification has been amended to replace the word "propagation" with the word "extent". No new matter has been introduced.

Objection to claims 6, 11, and 12

With respect to claim 6, the Office Action states that the term "active zone" lacks antecedent basis. Claim 6 has been amended to provide antecedent basis for the term "active zone".

With respect to claim 11, the Office Action states that the recited subject matter fails to further limit the preceding claim. Claim 11 has been suitably amended.

With respect to claim 12, the Office Action states that use of the work "like" renders the claim indefinite. Claim 12 has been appropriately amended.

Applicant submits that these objections have accordingly been overcome.

Rejection of claims 1-8 and 12-14 under 35 U.S.C. §103(a)

The Office Action states that the combination of Haerle and Shi teaches all of Applicant's recited elements. Applicant disagrees.

Independent claim 1 has now been amended to clarify its recitation of a method for the production of a plurality of optoelectronic semiconductor chips each having a plurality of structural elements with each structural element comprising at least one semiconductor layer that includes the steps of "essentially simultaneously growing semiconductor layers to form the structural elements on regions of the growth surface that lie within the windows", and "singulating the chip composite base with applied material to form semiconductor chips each having a plurality of structural elements". Support for these claim amendments can for example be found in paragraph [0038] of Applicants' published specification. The scope of claim 1 is deemed to be the same as that originally presented.

Haerle and Shi, whether taken alone or in combination, fail to teach or suggest the steps of "forming on the growth surface a mask material layer, with a multiplicity of windows, most of

which have an average extent of less than or equal to 1 μm", "essentially simultaneously growing semiconductor layers to form the structural elements on regions of the growth surface that lie within the windows", and "singulating the chip composite base with applied material to form semiconductor chips each having a plurality of structural elements", as recited in Applicant's amended claim 1.

Applicant's recited invention is directed to a method for the production of a plurality of optoelectronic semiconductor chips each having a plurality of structural elements 12 with each structural element comprising at least one semiconductor layer. Applicant's recited method includes providing a chip composite base 5 having a substrate 4, a semiconductor layer or layer sequence 6, and a growth surface 3, and forming on the growth surface 3 a mask material 11 with a multiplicity of windows 2, most of which have an average extent of less than or equal to 1 μm. The mask material 1 is chosen so that a semiconductor material of the semiconductor layer that is to be grown in a later method step essentially cannot grow on the mask material or can only grow on the mask material in a substantially worse manner as compared with the growth surface 3. Applicant's recited method further includes essentially simultaneously growing semiconductor layers 8 to form the structural elements 12 on regions of the growth surface 3 that lie within the windows 2, and singulating the chip composite base 5 with applied material to form a plurality of semiconductor chips that each have a plurality of structural elements (see Fig. 2 of Applicant's specification).

The semiconductor layer sequence 6 arranged on the substrate 4 can have an active zone that emits electromagnetic radiation when a voltage is applied (see paragraph [0051] of Applicant's specification).

Further, as described in Applicant's specification, "extent is to be understood as the

length of a window projected onto a straight line, the straight line running in a principal extending plane of the mask material layer. The average extent is accordingly the extent of a window averaged over all directions" (see page 2, line 36 to page 3, line 4 and Fig. 1D of Applicant's specification). In other words, the average extent is the lateral extent of a window 2 averaged over all directions that lie within the principal extending plane of the mask material layer 11 (i.e., all lateral directions of the window 2 in Fig. 1D).

Haerle discloses a method for fabricating a plurality of LED semiconductor bodies. According to the method of Haerle, the plurality of LEDs are produced by first depositing a mask layer on a main surface of a substrate wafer. A plurality of windows are then formed in the mask layer of Haerle such that the wafer surface is laid bare in the windows. A semiconductor layer sequence that functionally defines the semiconductor bodies is then deposited onto the main surface in the windows of Haerle. Finally, the wafer of Haerle is divided and severed into individual LEDs (see Figs. 5 and 6 and the Abstract of Haerle).

The Examiner cites Fig. 4 of Haerle as teaching essentially simultaneously growing semiconductor layers on regions of the growth surface that lie within the windows.

According to Haerle, the semiconductor layers which are deposited in the substrate surface through the mask windows functionally form the LEDs (see col. 7, lines 1-5 of Haerle). Nothing in Haerle, however, teaches or suggests that the deposited semiconductor layers form structural elements of the resulting semiconductor bodies, or that the resulting chips include a plurality of structural elements each comprising at least one semiconductor layer, as expressly recited in Applicant's claim 1.

The Examiner also cites col. 7, lines 33-36 and Figs. 5-6 of Haerle as teaching singulating the chip composite base with applied material to form semiconductor chips.

The cited passages and figures of Haerle in fact teach that once the chip is singulated, each device comprises a semiconductor sequence forming a single LED without any structural elements. This teaching is in stark contrast to Applicant's recited method in which chip singulation of the composite base with applied material results in the formation of a plurality of semiconductor chips, each of which includes a plurality of structural elements each comprising at least one semiconductor layer.

Furthermore, as is known to those skilled in the art, the lateral dimensions of optoelectronic semiconductor chips are typically on the order of several hundred μm, with smaller chips having a length of approximately 250 μm, and larger chips a length of approximately 1000 μm. The semiconductor layer sequence of each chip taught by Haerle is therefore between about 250 and 1000 μm. Consequently, the semiconductor layer sequence taught by Haerle has nothing to do with the plurality of structure elements recited in applicant's claims, which result in chips in the order of 1 μm or less. The lateral dimensions of Applicant's recited structural elements are more than two magnitudes smaller than the lateral dimensions of the semiconductor layer sequence taught by Haerle, since Applicant's structural elements are produced by selective growth within a very small window having an average extent of less than or equal to 1 μm, as discussed above.

Haerle, therefore, fails to teach or suggest "essentially simultaneously growing semiconductor layers to form the structural elements on regions of the growth surface that lie within the windows", and "singulating the chip composite base with applied material to form semiconductor chips each having a plurality of structural elements", as recited in Applicant's amended claim 1.

Shi discloses an organic full color light emitting diode array that includes a plurality of spaced apart, light transmissive electrodes formed on a substrate, a plurality of cavities defined on top of the electrodes, and three electroluminescent media designed to emit three different hues deposited in the cavities. A plurality of spaced metallic electrodes are arranged orthogonal to the light transmissive electrodes of Shi and are formed to seal each of the cavities, thereby sealing the electroluminescent media in the cavities. A light transmissive anodic electrode is disposed at the bottom of each cavity of Shi, and an ambient stable cathodic metallic electrode is disposed on the top of each cavity (see Abstract of Shi).

The Examiner cites col. 4, lines 15-27, and col. 5, line 66-col. 6, line 8 of Shi as teaching a multiplicity of windows, most of which have an average extent of less than or equal to 1 μm, and interprets "average extent" to be the depth of the windows. Applicant submits that the Examiner has misinterpreted the meaning of Applicant's recited "average extent".

As discussed above, Applicant's "average extent" is the lateral extent of a window 2 averaged over all directions that lie within the principal extending plane of the mask material layer 11. In other words, the average extent is a lateral extent of the window 2 and not a vertical extent of the window 2. With smaller windows in the mask material layer, it is possible to produce smaller structure elements in a larger area density (see paragraph [0013] of Applicant's specification). The depth of the window 2 quite obviously has no significance when a large area density of structure elements is to be achieved.

In contrast to Applicant's recited "average extent", the cited passages of Shi refer to the depth of cavity structure 112, not to an average of its lateral dimensions. Shi merely discloses that the thickness of the dielectric medium 103 determines the depth of the cavity structure and can be less than 1 μm (see col. 4, lines 25 to 27 of Shi), the lateral extent of the cavity structure

being significantly larger (see col. 5, line 66 to col. 6, line 8 of Shi).

Shi therefore fails to teach or suggest "forming on the growth surface, a mask material layer with a multiplicity of windows, most of which have an average extent of less than or equal to 1 μm", as expressly recited in Applicant's claim 1. Further, Shi also fails to teach or suggest "essentially simultaneously growing semiconductor layers to form the structural elements on regions of the growth surface that lie within the windows", and "singulating the chip composite base with applied material to form semiconductor chips each having a plurality of structural elements", as also recited in Applicant's amended claim 1.

Moreover, a person skilled in the art would not be motivated to combine the teachings of Haerle and Shi because Haerle relates to inorganic optoelectronic semiconductor chips whereas Shi is directed to organic light-emitting diodes (OLEDs). The different and disparate materials of each technology would not motivate one skilled in the art to combine the respective teachings of these references.

Thus Haerle and Shi, whether taken alone or in combination, fail to teach or suggest the steps of "forming on the growth surface a mask material, with a multiplicity of windows, most of which have an average extent of less than or equal to 1 μm", "essentially simultaneously growing semiconductor layers to form the structural elements on regions of the growth surface that lie within the windows", and "singulating the chip composite base with applied material to form semiconductor chips each having a plurality of structural elements", as expressly recited in Applicant's amended claim 1.

Claim 14 recites limitations corresponding to those of claim 1 and is, therefore, deemed to be patentably distinct over Haerle and Shi for at least those reasons discussed above with respect to independent claim 1.

In view of the foregoing, Applicant submits that Haerle and Shi, whether taken alone or in combination, fail to teach or suggest the subject matter recited in independent claims 1 and 14. Accordingly, claims 1 and 14 are patentable over Haerle and Shi under 35 U.S.C. §103(a).

Dependent claims

Claims 2-8 and 12-13, which depend from independent claim 1, incorporate all of the limitations of independent claim 1 and are, therefore, deemed to be patentably distinct over Haerle and Shi for at least those reasons discussed above with respect to independent claim 1.

Rejection of claims 9-11 under 35 U.S.C. §103(a)

The Office Action states that the combination of Haerle, Shi, and Braun teaches all of Applicant's recited elements.

Haerle and Shi have been previously discussed and do not teach or suggest the subject matter recited in Applicants' independent claim 1.

Because Haerle and Shi fails to teach or suggest the subject matter recited in Applicant's independent claim 1, and because Braun does not teach or suggest any of the method steps of independent claim 1 that Haerle and Shi are missing, the addition of Braun to the reference combination fails to remedy the above-described deficiencies of Haerle and Shi.

Claims 9-11, which depend from independent claim 1, incorporate all of the limitations of independent claim 1 and are, therefore, deemed to be patentably distinct over Haerle, Shi, and Braun for at least those reasons discussed above with respect to independent claim 1.

Newly added claim 15

Claim 15 has been newly added. Support for claim 15 can be found in original claim 6. Claim 15, which depends from independent claim 1, incorporates all of the limitations of independent claim 1 and is, therefore, deemed to be patentably distinct over the cited references for at least those reasons discussed above with respect to independent claim 1.

Conclusion

In view of the foregoing, reconsideration and withdrawal of all rejections, and allowance of all pending claims, is respectfully solicited.

Should the Examiner have any comments, questions, suggestions, or objections, the Examiner is requested to telephone the undersigned to facilitate an early resolution of any outstanding issues.

Respectfully submitted,
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